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(54) DIAGNOSTIC SYSTEM FOR A MODULAR FIELDBUS BOARD

DIAGNOSTISCHES SYSTEM FÜR EIN MODULARES FELDBUS-BOARD

SYSTEME DE DIAGNOSTIC POUR PANNEAU MODULAIRE DE BUS DOMOTIQUES

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WO-A-02/099663
DE-A- 10 104 908
US-A- 5 757 265
US-A- 5 831 805
US-A1- 2002 169 582

Attachment A

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Description

[0001] This invention relates to a modular fieldbus board with a diagnostic system, for use particularly to monitor fieldbus physical layer characteristics on a modular fieldbus board carrying a number of fieldbuses.

[0002] Modular fieldbus boards and the fieldbus systems to which they are attached occasionally suffer from faults which lead to a reduction in performance, or a complete failure. There is currently no known way to monitor the performance of the components of a modular field bus board to detect and diagnose faults and failures. As such, characteristics of performance which are indicative of potential faults are not detected, and faults and failures which actually occur cannot be easily identified for rectification.

[0003] It is know to provide diagnostic systems for bus structures. For example, US 5831805 in the name of LOTOCKY DAN ET AL discloses a basic diagnostic circuit applied to a node in a bus structure which detects if sufficient power is being supplied from a local power supply to physical connections within the node. If the power is not sufficient the disclosed circuit disables a clock signal to those physical connections in order to save power.

[0004] In US-A-5831805 there is disclosed a local power failure detection and clock disabling circuit operating within a node coupled to a bus structure. The node includes multiple ports and physical connections for supporting multiple applications. Each physical connection serves as a bus transceiver for receiving and transmitting communications over the bus structure. The node includes a local power supply and a clock signal which is provided to each of the physical connections within the node. A detection circuit is coupled to the local power supply for detecting whether or not a sufficient level of power is being supplied from the local power supply. The clock signal is always provided to a master physical connection within the node, which is responsible for repeating communications across the bus structure. The master physical connection draws power from the backup power supply source when the local power supply is not supplying a sufficient level of power. When the detection circuit has detected that the local power supply is not supplying a sufficient level of power, the clock signal is disabled to all of the physical connections within the node, except the master physical connection, in order to minimize power consumption of the node. The local applications coupled to the node are also disabled when a sufficient level of power is not supplied from the local power supply. When the detection circuit detects that the local power supply is again supplying power at a sufficient level, the clock signal is reenabled to all of the physical connections within the node and the local applications are also reenabled.

[0005] In US-A-5757265 there is disclosed a field bus system in which transmission ability of the system can be maintained even if communication error occurs due to noises or failure of a transmission line. The system can be easily shifted at a lower cost from a conventional system to the field bus system without degrading the high reliability thereof. The transmission line is constituted by a multiple-cable transmission line having at least three transmission cables. An external power supply supplies power to field devices through a pair of transmission cables of the multiple-cable transmission line. The field devices are connected to the transmission cables through a transmission line switching unit constituted by a plurality of rectifier elements, so that the field devices are supplied with current flowing in one predetermined direction when any of the pairs of transmission cables is selected. The external power supply monitors a failure of a currently used pair of transmission cables and, upon detection of failure of the currently used pair of transmission cables, the failed pair is replaced by a normal pair of transmission cables such that the field devices are continuously supplied with power.

[0006] In US-A1-2002/169582 there is disclosed a field device coupleable to a fieldbus process communication loop, the device comprising: a power module coupleable to the loop to power the device with energy received from the loop, a fieldbus loop communicator coupleable to the loop, and adapted to bi-directionally communicate over the loop, a controller coupled to the fieldbus loop communicator, diagnostic circuitry coupled to the controller and operably coupleable to the loop, the diagnostic circuitry adapted to measure a loop-related parameter, and wherein the controller provides diagnostic information based upon the loop-related parameter.

[0007] In WO-A-02/099663 there is disclosed an intrinsically safe field bus system comprising a field bus, a power source, a terminating resistor and at least one field bus device connected to the field bus. The power source is connected to a first end of the field bus and the terminating resistor terminates the field bus on the other end. The power source generates a periodic alternating signal, has a reactance as a terminating resistor and a unit for control and adjustment of the power source according to the input impedance (ZBus) of the field bus. The field bus input current (IBus) is kept constant when the input impedance (ZBus) in a first range of operation (I) is smaller than the wave impedance (ZW) of the field bus line, and the field bus input voltage (UBus) is adjusted to a constant maximum voltage (Umax) and the field bus input current (IBus) is adjusted according to the input impedance (ZBus) if the input impedance (ZBus) exceeds the value of the wave impedance (Zw) in a second operating range (II).

[0008] In DE-A-10104908 there is disclosed an electronic device for permanent monitoring electrically measurable states or values of bus systems, such as Profibuses, field buses, etc., after the bus has been installed, with two bus conductors, a comprehensive power supply and data bus, that connects a bus master and a bus slave together. Accordingly the device samples a number of connections of the electrically measurable bus conductors using a permanent circuit connection for voltage or

current measurement, testing earth connection testing the quality of the bus conductors and the signals they carry. The current testing of bus systems is based on connection of measurement meters and multimeters after installation to test the bus system and to correct any faults.

[0009] What is needed is a diagnostic system for a modular field bus board carrying a number of fieldbuses connected to a bulk power supply, comprises a monitoring transceiver means, such that the monitoring transceiver means can detect one or more fieldbus physical layer characteristics.

[0010] The present invention is intended to overcome some of the above problems.

[0011] Therefore, according to the present invention a modular fieldbus board comprising a number of fieldbuses connectable in use to a bulk power supply, is characterised in which: the modular fieldbus board is provided with a diagnostic system comprising a monitoring transceiver means connected to one or more of the number of fieldbuses, in which each connection to a fieldbus comprises one or more common mode and/or differential mode signal injection points and one or more corresponding common mode and/or differential mode signal detection points, in which said points are dispersed between the points at which the fieldbus is connectable to the bulk power supply and to a fieldbus trunk, and in which the monitoring transceiver means is adapted to detect one or more fieldbus physical layer characteristics between any signal injection point and any signal detection point.

[0012] Preferably the field bus physical layer characteristics which are monitored comprise one or more of: over/under termination, noise/ripple level, signal level, signal bias, signal jitter, signal ringing, signal distortion, signal attenuation, cross talk, unbalance, and earth leakage.

[0013] In a preferred construction the modular fieldbus board can carry hardware and the monitoring transceiver means can also be adapted to detect one or more characteristics of hardware disposed between any signal injection point and any signal detection point. The hardware can be bulk power supply connections, power supply converters, power supply conditioners and fieldbus trunks. The characteristics to be monitored can comprise one or more of: voltage, short circuit, hardware module failure, quiescent current, and rate of charge.

[0014] The monitoring transceiver means can also be adapted to gather received data and produce one or more of: Fourier analysis, trending analysis, and data logging.

[0015] Preferably the monitoring transceiver means may be adapted to provide an alarm in the event that received data indicates that one or more of pre-determined failures has occurred on any of the fieldbuses.

[0016] In one construction the monitoring transceiver means can be provided with a first digital and/or an analogue interface, such that diagnostic data detected and/or alarms generated by the monitoring transceiver means in use can be transmittable to a digital or analogue device operated by a user, and such-that user operating commands can be receivable from a digital or analogue device operated by a user.

[0017] Alternatively, or in addition to the first interface, the monitoring transceiver means can be provided with visual means adapted to display diagnostic data detected and/or alarms generated in use.

[0018] In addition, the monitoring transceiver means can be provided with a second digital and/or an analogue interface, such that diagnostic data detected and/or alarms generated by the monitoring transceiver means in use can be transmittable to other associated diagnostic systems, and such that data can be receivable from other associated diagnostic systems.

[0019] Preferably the monitoring transceiver means can be releasably connected to the fieldbus board, and it can be connectable in use by a bulk power supply.

[0020] In one construction one or more of the signal injection points and/or one or more of the signal detection points can be disposed within the hardware referred to above.

[0021] Preferably each of the one or more fieldbuses can comprise a point at which it is connectable to a the bulk power supply, a power supply converter, a power supply conditioner and a point at which it is connectable to a fieldbus trunk.

[0022] On each of the one or more fieldbuses a first common mode signal injection and/or signal detection point can be disposed between the point at which the fieldbus is connectable to a bulk power supply and the power supply converter, a second common mode signal injection and/or signal detection point can be disposed between the power supply converter and the power supply conditioner, a third a common mode signal injection and/or signal detection point can be disposed between the power supply conditioner and the point at which the field bus is connectable to a field bus trunk, and a differential mode signal injection and/or signal detection point can be disposed between the third common mode signal injection and/or signat-detection point and the point at which the fieldbus is connectable to a fieldbus trunk.

[0023] In addition, in a preferred construction a fourth common mode signal injection and/or signal detection point can be disposed within the power supply converter, and a fifth common mode signal injection and/or signal detection point can be disposed within the power supply conditioner.

[0024] The invention can be performed in various ways, but one embodiment will now be described by way of example and with reference to Figure 1, which shows a diagrammatic display of a modular fieldbus board according to the present invention.

[0025] As shown in Figure 1, a modular fieldbus board 15 comprising a backplane, on which is mounted any number of fieldbuses 8a, 8b and 8n in series and a monitoring transceiver means 17, (which may also be described by those in the art as a segment autonomous diagnostic system). (The fieldbuses comprise at least

fieldbuses 8a and 8b, while 8n diagrammatically signifies any number of further fieldbuses, and is therefore shown in hashed lines.)

[0026] The modular fieldbus board 15 is shown in an in use configuration and as such the field buses 8a to 8n are connected to bulk power supply 1, and each comprise a power supply converter 3 and a power conditioner 5.

[0027] The monitoring transceiver means 17 is provided with a first digital interface, signified by arrow 16, which in use interfaces with a user operated digital control system. Further the monitoring transceiver means 17 is provided with a second digital interface, signified by hashed arrow 19, which in use can interface with similar diagnostic systems provided on associated modular fieldbus boards (not shown).

[0028] The monitoring transceiver means 17 is further provided with visual means (signified by arrows 14) which can provide information and warning signals direct to users.

[0029] The monitoring transceiver means 17 is connected to each fieldbus 8a to 8n by first common mode signal injection and detection point 2 between the bulk power supply 1 and the power supply converter 3, by second common mode signal injection and signal detection point 4 between the power supply converter 3 and the power supply conditioner 5, by third a common mode signal injection and signal detection point 6 between the power supply conditioner 5 and the field bus trunk (not shown), and by differential mode signal injection and signal detection point 7 between the third common mode signal injection and signal detection point 6 and the fieldbus trunk (not shown).

[0030] In addition, the monitoring transceiver means 17 is connected to each fieldbus by fourth common mode signal injection and signal detection point (not visible, but indicated by connection arrow 9) which is disposed within the power supply converter 3, and by fifth common mode signal injection and signal detection point (again, not visible but indicated by connection arrow 11) disposed within the power supply conditioner 5.

[0031] The monitoring transceiver means 17 can monitor for fieldbus physical layer characteristics including over/under termination, noise/ripple level, signal level, signal bias, signal jitter, signal ringing, signal distortion, signal attenuation, cross talk, unbalance, and earth leakage, between any of the above described points.

[0032] In addition, the monitoring transceiver means 17 can monitor for voltage, short circuit, hardware module failure, quiescent current, and rate of charge, between any of the above described points.

[0033] The monitoring transceiver means 17 is programmed to compile received data in use and produce Fourier analysis, trending analysis, and data logging.

[0034] Further, the monitoring transceiver means 17 is programmed to provide an alarm, either via the interfaces 16 or 19, or the visual means 14, in the event that data in use indicates one or more of pre-determined failures or the one or more fieldbuses. The indications of failures in the data are pre-programmed into the transceiver 17.

[0035] Thus, the modular fieldbus board can provide many types of information on its performance and on any potential failures to a user.

Claims

1. A modular fieldbus board (15) comprising a number of fieldbuses (8a to 8n) connectable in use to a bulk power supply (1), **characterised in** which: the modular fieldbus board (15) is provided with a diagnostic system comprising a monitoring transceiver means (17) connected to one or more of the number of fieldbuses (8a to 8n), in which each connection to a fieldbus (8a to 8n) comprises one or more common mode and/or differential mode signal injection points (2, 4, 6, 7, 9 or 11) and one or more corresponding common mode and/or differential mode signal detection points (2, 4, 6, 7, 9 or 11), in which said points (2, 4, 6, 7, 9 or 11) are dispersed between the points at which the fieldbus (8a to 8n) is connectable to the bulk power supply (1) and to a fieldbus trunk, and in which the monitoring transceiver means (17) is adapted to detect one or more fieldbus physical layer characteristics between any signal injection point (2, 4, 6, 7, 9 or 11) and any signal detection point (2, 4, 6, 7, 9 or 11).

2. A modular fieldbus board (15) as claimed in Claim 1 in which the fieldbus physical layer characteristics comprise one or more of: over/under termination, noise/ripple level, signal level, signal bias, signal jitter, signal ringing, signal distortion, signal attenuation, cross talk, unbalance, and earth leakage.

3. A modular fieldbus board (15) as claimed in Claim 1 or 2 in which the modular fieldbus board (15) carries hardware (3, 5) and in which the monitoring transceiver means (17) is also adapted to detect one or more characteristics of hardware (3, 5) disposed between any signal injection point (2, 4, 6, 7, 9 or 11) and any signal detection point (2, 4, 6, 7, 9 or 11).

4. A modular fieldbus board (15) as claimed in Claim 3 in which the one or more characteristics of hardware (3, 5) comprise one or more of: voltage, short circuit, hardware module failure, quiescent current, and rate of charge.

5. A modular fieldbus board (15) as claimed in Claim 4 in which the monitoring transceiver means (17) is adapted to gather received data and produce one or more of: Fourier analysis, trending analysis, and data logging.

6. A modular fieldbus board (15) as claimed in any of

the preceding Claims in which the monitoring transceiver means (17) is adapted to provide an alarm in the event that received data indicates that one or more of pre-determined failures has occurred on any of the fieldbuses (8a to 8n).

7. A modular fieldbus board (15) as claimed in any of the preceding Claims in which the monitoring transceiver means (17) is provided with a first digital and/or an analogue interface (16), such that diagnostic data detected and/or alarms generated by the monitoring transceiver means (17) in use are transmittable to a digital or analogue device operated by a user, and such that user operating commands are receivable from a digital or analogue device operated by a user.

8. A modular fieldbus board (15) as claimed in Claim 7 in which the monitoring transceiver means (17) is provided with a second digital and/or an analogue interface (19) such that diagnostic data detected and/or alarms generated by the monitoring transceiver means (17) in use are transmittable to other associated diagnostic systems, and such that data is receivable from other associated diagnostic systems

9. A modular fieldbus board (15) as claimed in any of Claims 6 to 8 in which the monitoring transceiver (17) means is provided with visual means adapted to display diagnostic data detected and/or alarms generated in use.

10. A modular fieldbus board (15) as claimed in any of the preceding Claims in which the monitoring transceiver means (17) is releasably connected to the fieldbus board (15).

11. A modular fieldbus board (15) as claimed in any of the preceding Claims in which the monitoring transceiver means (17) is connectable to a bulk power supply (1).

12. A modular fieldbus board (15) as claimed in any of the preceding Claims 3-11 in which one or more of the signal injection points (2, 4, 6, 7, 9 or 11) and/or one or more of the signal detection points (2, 4, 6, 7, 9 or 11), are disposed within said hardware (3, 5).

13. A modular fieldbus board (15) as claimed in any of the preceding Claims 3-12 in which each of the one or more fieldbuses (8a to 8n) comprises a point at which it is connectable to a bulk power supply (1), a power supply converter (3), a power supply conditioner (5) and point at which it is connectable to a fieldbus trunk.

14. A modular fieldbus board (15) as claimed in Claim 13 in which in each of the one or more fieldbuses (8a to 8n) a first common mode signal injection and/or signal detection point (2) is disposed between the point at which the fieldbus is connectable to a bulk power supply (1) and the power supply converter (3), in which a second common mode signal injection and/or signal detection point (4) is disposed between the power supply converter (3) and the power supply conditioner (5), in which third a common mode signal injection and/or signal detection point (6) is disposed between the power supply conditioner (5) and the point at which the fieldbus is connectable to a fieldbus trunk, and in which a differential mode signal injection and/or signal detection point (7) is disposed between the third common mode signal injection and/or signal detection point (6) and the point at which the fieldbus is connectable to a fieldbus trunk.

15. A modular fieldbus board (15) as claimed in Claim 14 in which a fourth common mode signal injection and/or signal detection point (9) is disposed within the power supply converter (3), and in which a fifth common mode signal injection and/or signal detection point (11) is disposed within the power supply conditioner (5).

Patentansprüche

1. Modulare Feldbusplatine (15), die eine Vielzahl von Feldbussen (8a bis 8n) umfasst, welche an eine Gesamtenergieversorgung (1) für deren Einsatz anschließbar sind, **dadurch gekennzeichnet, dass** die modulare Feldbusplatine (15) mit einem diagnostischen System bereitgestellt wird, welches einen Überwachungstransceiver (17) aufweist, der mit einem oder mit mehreren aus der Vielzahl der Feldbusse (8a bis 8n) verbunden ist, in welcher jede Verbindung zu einem Feldbus (8a bis 8n) einen oder mehrere Gleichtakt- und/oder Differenztakt-Signaleingabekontaktbereiche (2, 4, 6, 7, 9 oder 11) und/oder eine oder mehrere korrespondierende Gleichtakt- und/oder Differenztakt-Signalerfassungskontaktbereiche (2, 4, 6, 7, 9 oder 11) umfasst, in welcher diese Kontaktbereiche (2, 4, 6, 7, 9 oder 11) zwischen den Kontaktpunkten verteilt sind, an denen der Feldbus (8a bis 8n) zu der Gesamtenergieversorgung (1) und zu einer Feldbusleitung anschließbar ist, und in welcher der Überwachungstransceiver (17) zum Erfassen von einer oder von mehreren der Charakteristiken in der physikalischen Feldbusschicht zwischen jedem Signaleingabekontaktbereich (2, 4, 6, 7, 9 oder 11) und jedem Signalerfassungskontaktbereich (2, 4, 6, 7, 9 oder 11) ausgelegt ist.

2. Modulare Feldbusplatine (15) gemäß Anspruch 1, in

welcher die physikalischen Feldbusschichtcharakteristiken eine oder mehrere der folgenden sind: Fehlanpassung, Rausch-/Welligkeitspegel, Signalpegel, Signalvorspannung, Signal-Jitter, Signalschwingung, Signalverzerrung, Signaldämpfung, Übersprechen, Unsymmetrie und Erdschluss [Erdkontakt].

3. Modulare Feldbusplatine (15) gemäß Anspruch 1 oder 2, in welcher die modulare Feldbusplatine (15) Hardware (3, 5) enthält, und in welcher der Überwachungstransceiver (17) auch zum Erfassen von einer oder von mehreren der Charakteristiken in der Hardware (3, 5) ausgelegt ist, die sich zwischen jedem Signaleingabekontaktbereich (2, 4, 6, 7, 9 oder 11) und jedem Signalerfassungskontaktbereich (2, 4, 6, 7, 9 oder 11) befinden.

4. Modulare Feldbusplatine (15) gemäß Anspruch 3, in welcher die eine oder mehrere der Charakteristiken in der Hardware (3, 5) eine oder mehrere von folgenden Eigenschaften aufweisen können: Spannung, Kurzschluss, Hardwaremodul-Störung, Ruhestrom und Belastungsrate.

5. Modulare Feldbusplatine (15) gemäß Anspruch 4, in welcher der Überwachungstransceiver (17) zum Zusammentragen von empfangenen Daten und zum Erzeugen von einem oder mehreren der folgenden Größen ausgelegt ist: Fourier-Analyse, Trend-Analyse und Daten-Protokollierung.

6. Modulare Feldbusplatine (15) gemäß einem beliebigen der vorhergehenden Ansprüche, in welcher der Überwachungstransceiver (17) zum Bereitstellen eines Alarms für den Fall adaptiert ist, dass die empfangenen Daten anzeigen, dass eine oder mehrere der vorher festgelegten Störungen auf einem der Feldbusse (8a bis 8n) aufgetreten ist/sind.

7. Modulare Feldbusplatine (15) gemäß einem beliebigen der vorhergehenden Ansprüche, in welcher der Überwachungstransceiver (17) mit einer ersten digitalen und/oder einer analogen Schnittstelle (16) bereitgestellt ist, so dass die erfassten Diagnosedaten und/oder Alarmanzeigen, die durch den in Einsatz befindlichen Überwachungstransceiver (17) generiert wurden, an eine digitale oder analoge Einrichtung übertragen werden können, die von einem Anwender bedient wird, und so dass anwenderbezogene Eingabebefehle von einer digitalen oder analogen Einrichtung, die von einem Anwender bedient wird, empfangen werden können.

8. Modulare Feldbusplatine (15) gemäß Anspruch 7, in welcher der Überwachungstransceiver (17) mit einer zweiten digitalen und/oder analogen Schnittstelle (19) bereitgestellt ist, so dass die von dem in Betrieb befindlichen Überwachungstransceiver (17) erfassten Diagnosedaten und/oder erzeugten Alarmsignale zu anderen angeschlossenen Diagnosesystemen übertragen werden können, und so dass diese Daten von anderen angeschlossenen, diagnostischen Systemen empfangen werden können.

9. Modulare Feldbusplatine (15) gemäß einem beliebigen der Ansprüche 6 bis 8, in welcher der Überwachungstransceiver (17) mit Sichteinrichtungen bereitgestellt ist, die zum Anzeigen von erfassten Diagnosedaten und/oder Alarmsignalen ausgelegt sind, welche während der Anwendung generiert wurden.

10. Modulare Feldbusplatine (15) gemäß einem beliebigen der vorhergehenden Ansprüche, in welcher der Überwachungstransceiver (17) mit der Feldbusplatine (15) abnehmbar verbunden ist.

11. Modulare Feldbusplatine (15) gemäß einem beliebigen der vorhergehenden Ansprüche, in welcher der Überwachungstransceiver (17) mit der Gesamtenergieversorgung (1) verbunden ist.

12. Modulare Feldbusplatine (15) gemäß einem beliebigen der vorhergehenden Ansprüche 3 bis 11, in welcher sich ein oder mehrere der Signaleingabekontaktbereiche (2, 4, 6, 7, 9 oder 11) und/oder ein oder mehrere der Signalerfassungskontaktbereiche (2, 4, 6, 7, 9 oder 11) in der Hardware (3, 5) befinden.

13. Modulare Feldbusplatine (15) gemäß einem beliebigen der vorhergehenden Ansprüche 3 bis 12, in welcher jeweils der einzelne oder mehrere Feldbusse (8a bis 8n) einen Kontaktpunkt aufweisen, an dem eine Gesamtenergieversorgung (1), ein Energiekonverter (3), ein Energiekonditionierer (5) anschließbar sind, und einen Kontaktpunkt, an dem er zu einer Feldbusleitung verbunden werden kann.

14. Modulare Feldbusplatine (15) gemäß Anspruch 13, in welcher auf jeweils dem einzelnen oder auf mehreren der Feldbusse (8a bis 8n) sich eine erste Gleichtaktsignalinjektion und/oder ein Signalerfassungskontakt (2) zwischen dem Kontaktpunktbereich befinden, an welchem der Feldbus zu einer Gesamtenergieversorgung (1) und zu einem Energiekonverter (3) anschließbar ist, in welcher sich eine zweite Gleichtaktsignalinjektion und/oder ein Signalerfassungskontakt (4) zwischen dem Energiekonverter (3) und dem Energiekonditionierer (5) befinden, in welcher sich eine dritte Gleichtaktsignalinjektion und/oder ein Signalerfassungskontakt (6) zwischen dem Energiekonditionierer (5) und dem Kontaktpunktbereich befinden, an welchem der Feldbus zu einer Feldbusleitung anschließbar ist, und in welcher sich eine Differenztaktsignalinjektion und/oder ein Signalerfassungskontakt (7) zwischen

der dritten Gleichtaktsignalinjektion und/oder dem Signalerfassungskontakt (6) und dem Kontaktpunktbereich befinden, an welchem der Feldbus zu einer Feldbusleitung anschließbar ist.

15. Modulare Feldbusplatine (15) gemäß Anspruch 14, in welcher eine vierte Gleichtaktsignalinjektion und/oder ein Signalerfassungskontakt (9) innerhalb des Energiekonverters (3) angeordnet sind, und in welcher sich eine fünfte Gleichtaktsignalinjektion und/oder ein Signalerfassungskontakt (11) im Energiekonditionierer (5) befinden.

Revendications

1. Panneau modulaire de bus de terrain (15) comprenant un nombre de bus de terrain (8a à 8n) pouvant être connectés à un bloc d'alimentation (1), **caractérisé en ce que** le panneau modulaire de bus de terrain (15) est doté d'un système de diagnostic comprenant un dispositif émetteur-récepteur de surveillance (17) connecté à un ou plusieurs des bus de terrain (8a à 8n), dans lequel chaque connexion à un bus de terrain (8a à 8n) comprend un ou plusieurs points d'injection de signaux en mode commun et/ou en mode différentiel (2,4,6,7,9 ou 11), ainsi qu'un ou plusieurs points correspondants de détection de signaux en mode commun et/ou en mode différentiel (2,4,6,7,9 ou 11), lesdits points (2,4,6,7,9 ou 11) étant dispersés entre les points auxquels le bus de terrain (8a à 8n) peut être connecté au bloc d'alimentation (1) et à un tronçon de bus de terrain, et le dispositif émetteur-récepteur de surveillance (17) étant apte à détecter une ou plusieurs caractéristiques de la couche physique du bus de terrain entre chaque point d'injection de signaux (2,4,6,7,9 ou 11) et chaque point de détection de signaux (2,4,6,7,9 ou 11).

2. Panneau modulaire de bus de terrain (15) selon la revendication 1, dans lequel les caractéristiques de la couche physique du bus de terrain comprennent un ou plusieurs des facteurs suivants: défaut sur terminaison de ligne, niveau de bruit/d'ondulation, niveau de signal, biais du signal, gigue de signal, oscillation de signal, distorsion du signal, atténuation du signal, diaphonie, dissymétrie et perte à la terre.

3. Panneau modulaire de bus de terrain (15) selon la revendication 1 ou 2, dans lequel le panneau modulaire de bus de terrain (15) porte du matériel (3,5) et dans lequel le dispositif émetteur-récepteur de surveillance (17) est également en mesure de détecter une ou plusieurs caractéristiques du matériel (3,5) disposé entre un point d'injection de signaux (2,4,6,7,9 ou 11) et un point de détection de signaux (2,4,6,7,9 ou 11).

4. Panneau modulaire de bus de terrain (15) selon la revendication 3, dans lequel la ou les caractéristiques du matériel (3,5) comprennent un ou plusieurs des facteurs suivants: tension, court-circuit, défaillance d'un module matériel, courant de repos et taux de charge.

5. Panneau modulaire de bus de terrain (15) selon la revendication 4, dans lequel le dispositif émetteur-récepteur de surveillance (17) est en mesure de collecter les données reçues et d'effectuer une ou plusieurs des actions suivantes: analyse de Fourier, analyse de tendance et saisie des données.

6. Panneau modulaire de bus de terrain (15) selon l'une quelconque des revendications précédentes, dans lequel le dispositif émetteur-récepteur de surveillance (17) est en mesure d'émettre une alarme lorsque les données reçues indiquent qu'une ou plusieurs des défaillances prédéterminées se sont produites dans un bus de terrain quelconque (8a à 8n).

7. Panneau modulaire de bus de terrain (15) selon l'une quelconque des revendications précédentes, dans lequel le dispositif émetteur-récepteur de surveillance (17) est doté d'une première interface numérique et/ou analogique (16), de sorte que les données de diagnostic détectées et/ou les alarmes générées par le dispositif émetteur-récepteur de surveillance (17) en service peuvent être transmises à un dispositif numérique ou analogique exploité par un utilisateur et que les commandes d'opération de l'utilisateur peuvent être reçues à partir d'un dispositif numérique ou analogique exploité par un utilisateur.

8. Panneau modulaire de bus de terrain (15) selon la revendication 7, dans lequel le dispositif émetteur-récepteur de surveillance (17) est doté d'une deuxième interface numérique et/ou analogique (19), de sorte que les données de diagnostic détectées et/ou les alarmes générées par le dispositif émetteur-récepteur de surveillance (17) en service peuvent être transmises à d'autres systèmes de diagnostic associés et que les données provenant d'autres systèmes de diagnostic associés peuvent être reçues.

9. Panneau modulaire de bus de terrain (15) selon l'une quelconque des revendications 6 à 8, dans lequel le dispositif émetteur-récepteur de surveillance (17) est doté de moyens visuels aptes à afficher les données de diagnostic détectées et/ou les alarmes générées en service.

10. Panneau modulaire de bus de terrain (15) selon l'une quelconque des revendications précédentes, dans lequel le dispositif émetteur-récepteur de surveillance (17) est connecté au panneau de bus de terrain (15) de façon détachable.

11. Panneau modulaire de bus de terrain (15) selon l'une quelconque des revendications précédentes, dans lequel le dispositif émetteur-récepteur de surveillance (17) peut être connecté à un bloc d'alimentation (1).

12. Panneau modulaire de bus de terrain (15) selon l'une quelconque des revendications 3 à 11, dans lequel un ou plusieurs points d'injection de signaux (2,4,6,7,9 ou 11) et/ou un ou plusieurs points de détection de signaux (2,4,6,7,9 ou 11) sont disposés au sein dudit matériel (3,5).

13. Panneau modulaire de bus de terrain (15) selon l'une quelconque des revendications 3 à 12, dans lequel chacun du ou des bus de terrain (8a à 8n) comprend un point auquel il peut être connecté à un bloc d'alimentation (1), un convertisseur d'alimentation (3), un conditionneur d'alimentation (5) et un point auquel il peut être connecté à un tronçon de bus de terrain.

14. Panneau modulaire de bus de terrain (15) selon la revendication 13, dans lequel, dans chacun du ou des bus de terrain (8a à 8n), un premier point d'injection et/ou de détection de signaux en mode commun (2) est disposé entre le point auquel le bus de terrain peut être connecté à un bloc d'alimentation (1) et le convertisseur d'alimentation (3), dans lequel un deuxième point d'injection et/ou de détection de signaux en mode commun (4) est disposé entre le convertisseur d'alimentation (3) et le conditionneur d'alimentation (5), dans lequel un troisième point d'injection et/ou de détection de signaux en mode commun (6) est disposé entre le conditionneur d'alimentation (5) et le point auquel le bus de terrain peut être connecté à un tronçon de bus de terrain, et dans lequel un point d'injection et/ou de détection de signaux en mode différentiel (7) est disposé entre le troisième point d'injection et/ou de détection de signaux en mode commun (6) et le point auquel le bus de terrain peut être connecté à un tronçon de bus de terrain.

15. Panneau modulaire de bus de terrain (15) selon la revendication 14, dans lequel un quatrième point d'injection et/ou de détection de signaux (9) est disposé au sein du convertisseur d'alimentation (3) et dans lequel un cinquième point d'injection et/ou de détection de signaux en mode commun (11) est disposé au sein du conditionneur d'alimentation (5).

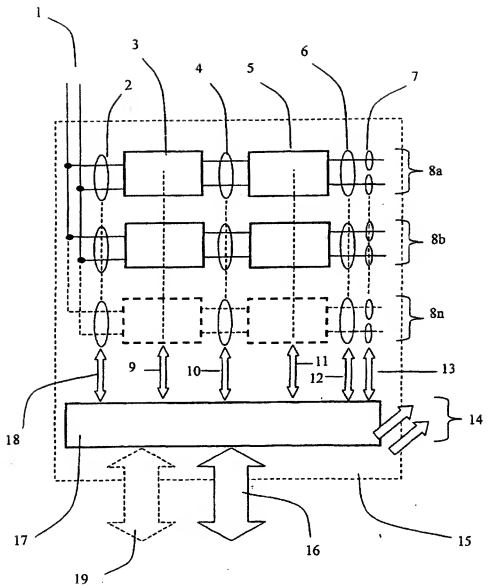

FIGURE I

REFERENCES CITED IN THE DESCRIPTION

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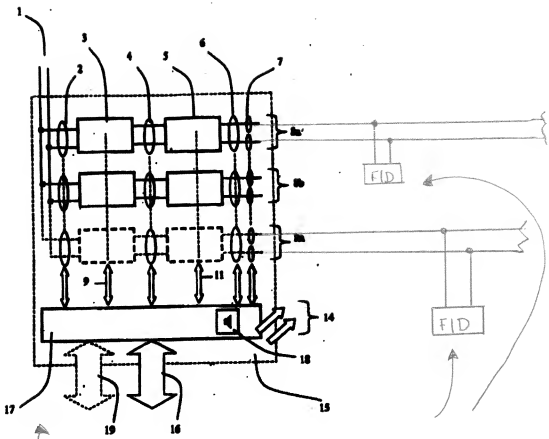

Present Application's Diagnostic System is at Power Supply of Network

FIGURE 1

Testing of Sceciaetal Eryurek etal Test at Field Device/ Module (F/D)

Attachment B

6.2.3.1 When installing FOUNDATION fieldbus in a Brownfield Facility, the existing homerun cables shall be tested for suitability for reuse. This test can be done using the Relcom FBT-3 and FBT-5 cable testing tools.

Commentary:
At present these are the only known simple handheld test products available for this service.

6.2.4 Spurs
A spur can vary in length from 1 meter to 200 meters (656 ft.). A spur that is less than 1 meter is considered a splice.

Commentary:
A spur that is less than two hundred (200) meters is negligible as a transmission line and can accurately be modeled as an equivalent capacitor. Note: quarter-wavelength at H1 frequencies is in excess of 2 kilometers. The spur length allowances given in this document are considerably more generous than allowed by the FF wiring guide provided by Relcom; however, these allowances are based on transmission line theory, lab tests, and field installation experience. Strictly following the original ISA 50 wiring guide can place unnecessary and costly restrictions on FF field wiring.

Only one (1) FOUNDATION fieldbus device shall be connected to each spur.

Commentary:
Since a short-circuit protection wiring block is being used, the segment design is limited to one (1) device per spur.

The maximum spur length shall be 200 meters (656 ft.). The spur length is the length of the cable from the wiring block to the FF device.

Commentary:
A spur is a drop-off of the main trunk line. The trunk is considered to be the main cable run and will contain segment terminators at each end.

While un-terminated spur lengths up to 200 meters are allowed, any spur over 100 meters (328 ft.) requires Principal approval. The intent of the selected multi-drop bus wiring method is to eliminate the need for long spur lengths and to keep spurs under the recommended length of 30 meters (98 ft.) or less. Longer spurs may be needed to keep the bus out of high-risk areas.

6.3 FOUNDATION fieldbus Power, Grounding & Lightning Protection

6.3.1 Power
Fieldbus devices may be powered either from the segment (bus), or locally powered, depending on the device design.

Commentary:
Bus-powered devices typically require 10-30 mA of current at between 9 and 32 volts. Any network/segment designed to operate below 15V normally should carry a warning about additional loads in the network documentation. Minimum network/segment voltage should always be shown in the network documentation.

The total current draw from all devices on the network must not exceed the rating of the FOUNDATION fieldbus Power Supply. The network/segment design must take into account:

- Total device quiescent current draw
- One spur short-circuit fault (i.e. ~10 mA additional current draw)
- 25% additional current load above the two (2) previous requirements

Attachment C